Long-Term Functional Results of a Wrist Exercise Program for Patients with Palmar Midcarpal Instability

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Abstract

Background Patients with palmar midcarpal instability have symptoms of pain, combined with clinical signs of abnormal mobility on stressing the joint, an unpredictable blockade feeling, and a noticeable clunk, in the absence of an underlying trauma. No data are available on the effect of conservative treatment for these patients.

Purpose The purpose of this study was to evaluate the effect and the long-term functional outcomes of a wrist exercise program in patients with palmar midcarpal instability.

Patients and Methods All patients diagnosed with palmar midcarpal instability between 2005 and 2011 were included. Patients completed the Patient-Rated Wrist and Hand Evaluation (PRWHE) and the Short Form-36 health (SF-36) questionnaires, scaled their perceived pain before and after treatment, and indicated the effect of the received treatment.

Results A total of 119 patients diagnosed with palmar midcarpal instability were included. The median follow-up time was 6 years (IQR 4.5–7.0). The median PRWHE score after hand therapy was 35.5 and the median mental component of the SF-36 score was 53.9 and the physical component was 45.2. The median perceived pain reduced from eight to four and the median therapeutic effect of the wrist exercise program was five.

Conclusion Although palmar midcarpal instability remains to be a chronic disease, the effectiveness of our wrist exercise program is promising with acceptable long-term functional results and a good quality of life.

Level of Evidence Level IV, retrospective cohort study.

Keywords
- midcarpal instability
- palmar
- conservative
- exercise program
- wrist
- PRWHE

Patients with palmar midcarpal instability have symptoms of pain, combined with clinical signs of abnormal mobility on stressing the joint, an unpredictable blockade feeling and a noticeable clunk, in the absence of an underlying trauma.[1] In palmar midcarpal instability, instability exists between the proximal carpal row and the distal carpal row, resulting in an abnormal movement pattern between the two.[2–4] The abnormal movement pattern is a result of laxity of the ligaments that connect the distal radius, to both proximal and distal carpal row (e.g., dorsal radiocarpal ligament, the triquetrum-capitate-hamate [TqCH] ligament and scaphoid-trapezium-trapezoid [STT] ligament).[4–6] Although a normal movement pattern of the wrist requires these ligaments to allow some laxity, in palmar midcarpal instability excessive laxity in the ligaments leads to abnormal motion between the proximal and distal row which is often associated with a painful clunk.[1,4,6,7]

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Although some surgical interventions have been proposed to augment or shorten the involved ligaments,[2,6,8,9] a conservative strategy is most commonly advocated, as outcome of such surgery is often disappointing and unpredictable and therefore only recommended when conservative treatment fails.[2,9–11] Conservative treatment strategies traditionally focus on immobilization with various wrist splints, isometric exercises, and reduction in pain with nonsteroidal anti-inflammatory medication.[2,4,6,12,13] In 1999, our institution developed a wrist exercise program specifically for patients with chronic wrist pain, including carpal instability.[14] This program aims to improve positioning, strengthening, and functional stabilization of the wrist during activities.[15] The rational for using it for patients with palmar midcarpal instability is that this exercise program focuses on improving strength and coordination of the extrinsic muscle of the wrist and hand. Training these active stabilizers of the wrist may compensate for the ligamentous instability of the carpus and therefore improve qualitative control of movement and functional wrist stability.[16] The exercises are as functional as possible and directed at the problematic actions of the patient. With the optimization of mobility and strength and the gradually increasing stability and complexity of movement, it is possible to work toward these problematic activities. Furthermore, the therapist helps the patient to become aware of wrist positioning, compensatory movements and pain provoking activities during daily activities and work.

The wrist exercise program was offered to all patients with palmar midcarpal instability presenting in our institution since 1999. Because our institution is a tertiary center for wrist pathology and patients are referred from all over the country, the program was designed to be provided by a local hand therapist. Consequently, patients do not routinely return to our center and therefore the long-term results of our wrist exercise program are still unclear.

The aim of the current study was to determine the effectiveness and long-term functional outcomes of a wrist exercise program in patients with the diagnosis palmar midcarpal instability at a minimum of 3 years of follow-up.

Patients and Methods

Study Design and Population

All patients that were diagnosed with palmar midcarpal instability in a tertiary center for wrist pathology between 2005 and 2011 were retrospectively included in this study. Palmar midcarpal instability was diagnosed by a surgeon specialized in hand surgery when the Lichtman test was found to be positive during both physical examination and during wrist cineradiography in the absence of any other wrist pathology.[8] The Lichtman test is defined as a palmar translation of the hand at the level of the distal capitate as the wrist is simultaneously loaded axially and moved from radial to ulnar deviation. The test is positive when a painful rapid "catch-up" clunk occurs as the proximal carpal row jumps from flexion into extension, reproducing the patient's symptoms (►**Video 1**).[17–19] During wrist cineradiography, other carpal pathologies were excluded (e.g., carpal instability dissociative and/or a dorsal midcarpal instability).[20] Patients having palmar midcarpal instability combined with other wrist pathologies that were diagnosed either at clinical or radiological examination were excluded from this study.

Video 1

Positive Lichtman test during wrist cineradiography. A painful rapid "catch-up" clunk occurs as the proximal carpal row jumps from flexion into extension, reproducing the patient's symptoms. Online content including video sequences viewable at: www.thieme-connect.com/ejournals/html/doi/10.1055/s-0037-1612594.

Outcome

All eligible patients received an invitation to participate in the online survey. First they were sent a letter to join the online survey. Nonresponders were phoned and asked to participate. If they did not respond after three reminders, patients were considered lost to follow-up. The online survey was developed specifically for this study (►**Appendix**).

Patient characteristics were acquired, and job history and ability to work were investigated. Occupation was divided into white collar (physically very demanding), blue collar (physically not demanding), homeworker, retired, and unemployed due to complaints of the wrist.

To specify the treatment and exercises received, patients had to indicate specific key exercises of the wrist exercise program. These specific key exercises were defined as exercises focused on a correct position of wrist and hand (e.g., "straight wrist" during lifting, supportive bandage, recommendations regarding position of the hand) (►**Fig. 1**), and on stabilization of the wrist (e.g., "powerball," dynamic exercises with dumbbell, stabilization of a stock) (►**Fig. 2**). Patients were considered to have followed the wrist exercise program if at least they had followed one of these two key exercises. As a control, questions on treatment aimed at sole improvement in mobility and flexibility, pain relief, massage, manipulation, and physio technical applications were added, as they are known interventions less specific for, or even contradictory to the principles of the exercise program. If patients followed these exercises in addition to at least one of the key exercises, they were included. However, if patients only followed these control exercises, they were excluded for this study.

Patients were asked if they still had complaints regarding the affected wrist, and in case they had, to scale their perceived pain before and after treatment using a numerical scale from 0 (no pain) to 10 (worst pain possible). Moreover, patients were asked to indicate the effect of the received treatment (therapeutic effect) at a numerical scale from zero (no effect) to ten (maximum effect). Furthermore, patients had to give an indication of the duration of their complaints before the treatment started and if they received additional treatment afterwards.

Finally, each participant completed the Dutch language version of the Patient-Rated Wrist and Hand Evaluation

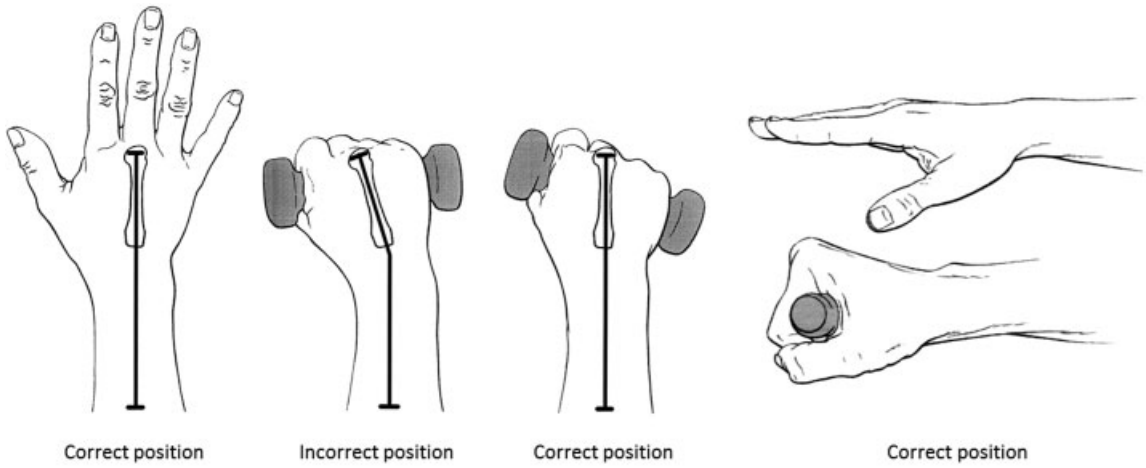

Fig. 1 Correct position of the wrist.

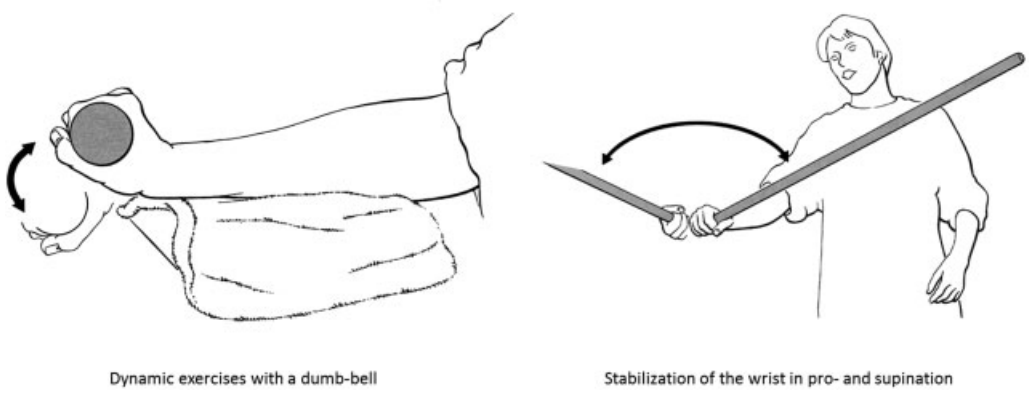

Fig. 2 Stabilization of the wrist.

(PRWHE) and the Short Form-36 health (SF-36) questionnaires. Both questionnaires are patient-reported outcomes. The PRWHE is a wrist-specific questionnaire on the basis of which patients have to rate their wrist pain and function on a scale of 0 to 10. The total score can be computed on a scale from 0 to 100. Higher scores indicate more pain and functional disability of the wrist.[21,22] The SF-36 is a widely used health survey that contains 36 items divided into 8 subscales: physical and social functioning, limitations due to physical and emotional problems, physical pain, general health, vitality and mental health. Patients have to scale the positions with respect to their health in the past 4 weeks. The total score ranges from 0 to 100 with higher scores indicating a better state of health.[23]

Statistical Analyses

Continuous data were presented as mean and standard deviation (SD) in case of normally distributed or as median and interquartile range (IQR) in case of non-normally distributed. Categorical data were presented as numbers with percentages. We used mean imputations to complete missing values of the questionnaires. The missing values in the PRWHE score were replaced per patient with the mean score of the concerning subscale if less than three questions were missing on the pain subscale and less than four questions on the function subscale as proposed by John et al.[24] The missing values of the SF-36 were replaced with the mean of the total score per patient. Mean imputations for the SF-36 questionnaire were only used if less than 50% of questions per patient were missing, according to the SF-36 manual. The SF-36 is divided in a physical component score (PCS) and a mental component score (MCS). Both component scores are calculated with regression weights of the Dutch norm population. Data were analyzed using SPSS, version 23.0 (IBM, Armonk, New York, NY).

Results

Included Patients

We retrospectively identified 399 patients who underwent wrist cineradiography between 2005 and 2011. Due to a negative Lichtman test or co-existing wrist pathology, 96 patients were excluded. A total of 166 patients (55%) completed the questionnaire. Forty-seven patients were excluded because they did not follow the wrist exercise program, based on the specific key exercises. This left a cohort of 119 patients (►**Fig. 3**).

The mean age of the patients at the time of wrist cineradiography was 29 years (SD 10.8) with a range of 11 to 64 years, and 84% were female. In 69% of the patients the dominant hand was affected, and 43 patients (36%) had bilateral palmar midcarpal instability. The median follow-up time was 6 years (IQR 4.5–7.0).

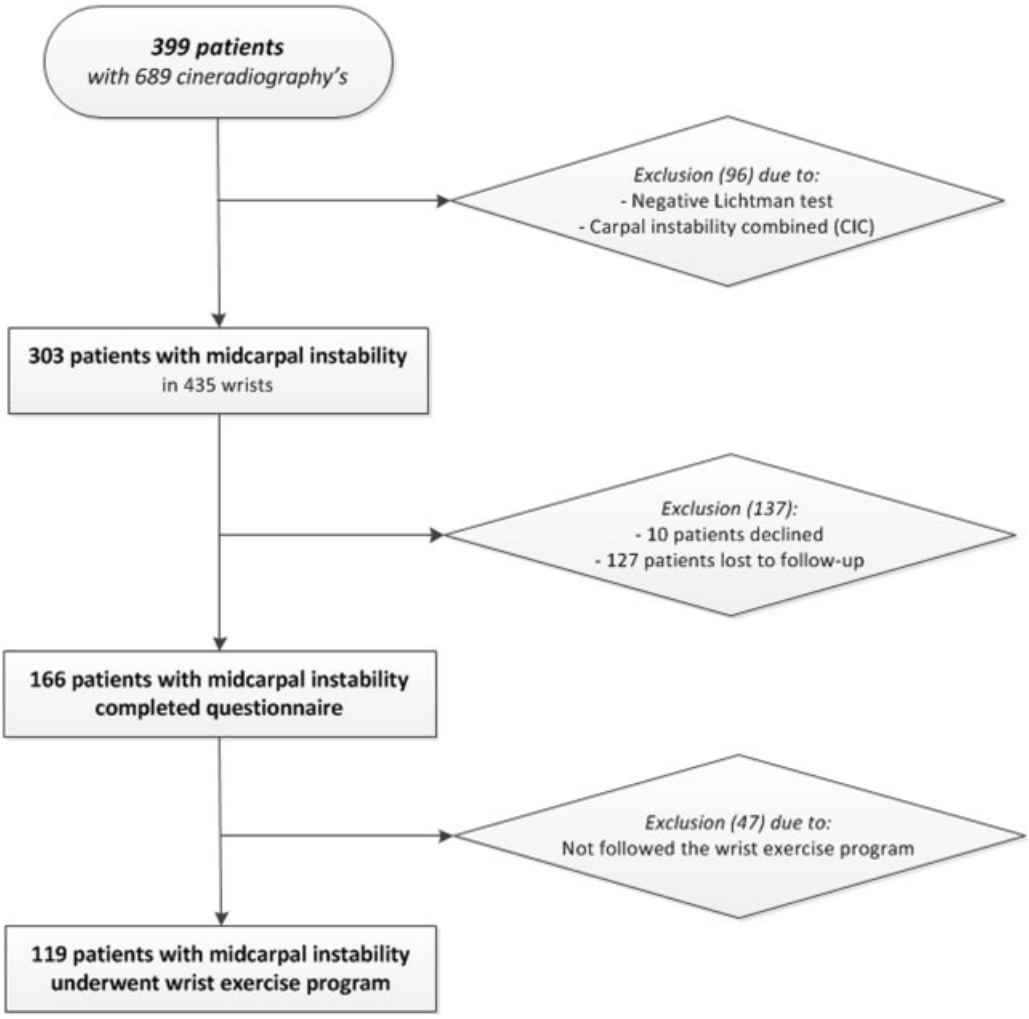

Fig. 3 Flow diagram of patient selection.

Effect of the Wrist Exercise Program

At first presentation, 62% of the patients already had complaints of pain and dysfunction for more than 1 year. After the wrist exercise program, 19% of the patients did not have any complaints anymore. Of the remaining 81% of patients, the median perceived pain reduced from eight (IQR 7–9) before start of the wrist exercise program to four (IQR 2–6) at the time of follow-up. Moreover, the median therapeutic effect of the wrist exercise program was five (IQR 2–8).

The median PRWHE score was 35.5 (IQR 13.0–50.5). The MCS of the SF-36 was 53.9 (IQR 48.0–57.4) and the PCS was 45.2 (IQR 37.4–52.6).

The majority of the patients (60%) had a white-collar job (e.g., administrative work) (►**Fig. 4**). In 40% of the patients, the wrist exercise program had a positive influence on the performance of the occupation. Thirty-one patients (27%) needed less adjustments and 15 patients (13%) could return to their previous occupational activities due to the wrist exercise program.

Compliance with the Wrist Exercise Program

Of the 119 patients who followed the wrist exercise program, 91% of the patients were still following the wrist exercise program after 1 month and 61% of the patients completed the wrist exercise program with a minimum duration of 12 weeks. Besides a correct position (87.4%) and stabilization exercises of the wrist (76.5%), exercises aiming to improve

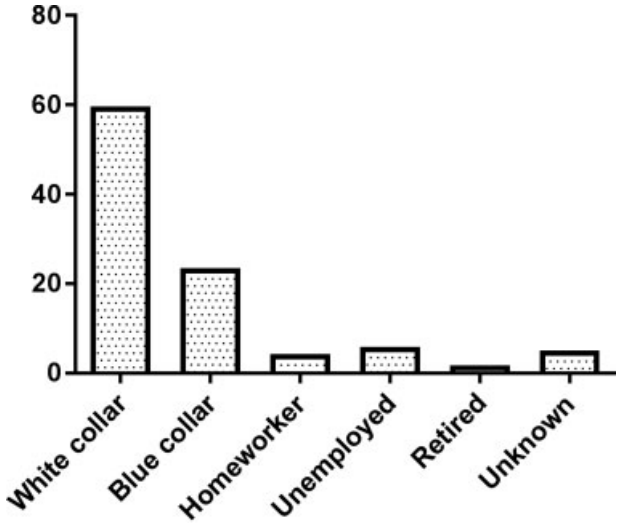

Fig. 4 Occupations.

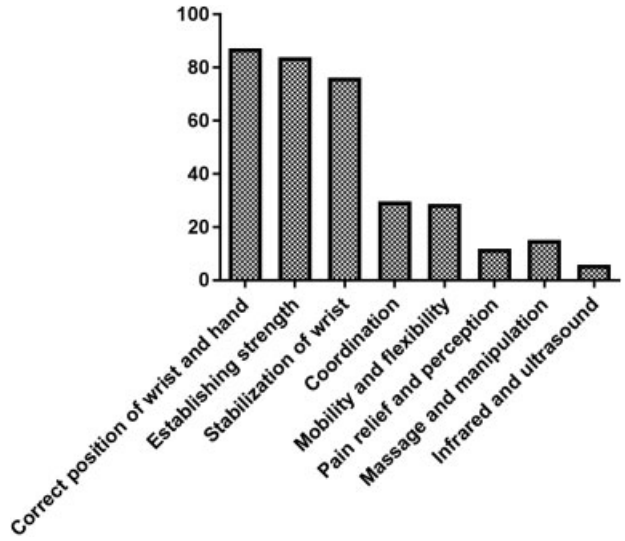

Fig. 5 Wrist exercises.

strength (84%) were most often applied. Exercises aiming at coordination (29.4%), mobility and flexibility (29.4%), pain relief and perception (12.6%), massage and manipulation (15.1%), and physio technical applications (5.9%) were less frequent applied (►**Fig. 5**).

Additional Treatment after the Wrist Exercise Program

After the wrist exercise program, 42 patients (35%) received additional treatment; 21 patients had an operation, mostly due to a ganglion, 11 patients received a brace, splint or other supportive bandage, six patients went to a physiotherapist not specialized in this wrist exercise program, three patients went to an alternative doctor, and one patient received medication due to the diagnosis rheumatoid arthritis at later stage. The patient who was diagnosed with rheumatoid arthritis had still a pain score of eight at the time of completing in the questionnaire.

Nine patients (8%) had suffered from a new trauma of the wrist after the wrist exercise program, in particular a fracture of the wrist due to a fall on outstretched hand.

Discussion

Palmar midcarpal instability is difficult to treat and often affects a relatively healthy and young population.[6,9] The present study is the first to show satisfactory long-term results of a wrist exercise program for 119 patients with palmar midcarpal instability with a median follow-up of six years.

After the wrist exercise program, 19% of the patients reported no further wrist pain. Of all patients who still had complaints of the affected wrist, the pain reduced four points on a numerical scale. The median therapeutic effect of the exercise program was five (on a scale of 0–10). Although patients indicated that they benefit from the wrist exercise program, they still had a median PRWHE score of 35.5 after 6 years. However, the quality of life in our patient population is comparable to normative data for the Dutch population for females between 26 and 35 (mean of 48.5 for the MCS and 53.8 for the PCS).

In a survey conducted in 2007 among 85 Australian Hand Therapy Association members, the most often used treatments for patients with wrist instability were splints, isometric exercises of the wrist musculature, and education.[13] However, splints often only reduce pain in the short-term and the risks of splint-dependency exist. In contrast, by functional re-education and strengthening exercises, the wrist exercise program aims to improve positioning, strengthening, and functional stabilization of the wrist during activities not only in the short term but also in the long term.

In a previous study by Lichtman et al, evaluation of conservative treatment in palmar midcarpal instability, including splint, steroid injection, anti-inflammatory drugs, and avoidance of aggravating activities, resulted in a noted relieve of symptoms in 6 of the 10 patients. In four patients, conservative management failed and surgical stabilization of the triquetrohamate joint was required.[17] In another study by Wright et al, seven non-operatively treated patients were compared with 38 operatively treated patients.[6] The non-operatively treated patients received a combination of splints, nonsteroidal anti-inflammatory medication and occasionally steroid injections, but the results were disappointing for both groups and only 60% of the non-operatively and operatively treated patients achieved good functional results. In both studies, the number of patients treated conservatively was low and no details regarding the therapy program were given.

Patients were included based on a positive Lichtman test during both physical examination and wrist cineradiography. Although wrist cineradiography is a globally accepted test to diagnose patients with palmar midcarpal instability, this test is not validated because there is no golden standard for diagnosing patients with palmar midcarpal instability.[19] Besides, during physical examination we found that patients with palmar midcarpal instability also have a positive ulnar support test and tenderness during pressure at the triquetrohamate joint. Perhaps, these tests could be of additional value in diagnosing palmar midcarpal instability.

Limitations of the present study reflect the retrospective nature of the study. At follow-up, patients had indicate the amount of pain they had before treatment started, which may have been subject to recall bias. They also had to indicate how many and which exercises they received. Responses may have been influenced by the time to follow up or patients could have forgotten details of the exercises received. In addition, we did not have PRWHE scores from before start of treatment and, therefore we cannot show the effectivity of the program using this score. Furthermore, we chose to include as large a group as possible, as to our opinion, children with midcarpal instability in principle do not differ from adults. Our cohort included 18 subjects that were not adult at the time of follow-up. Although the PRWHE questionnaire has not been validated for children and adolescents, we chose not to exclude the patients based on age, as the PRWHE score did not change after excluding all minors from our analysis (median PRWHE score 36 [IQR 13.5–50.5]).

Lastly, selection bias may have occurred because we included only patients with a long history of complaints seen in a tertiary center for wrist pathology and we do not know what the natural course would have been. Therefore, we do not know if patients would have improved the same without the exercise program. The placebo effect is always a concern in uncontrolled studies, especially in the evaluation of intensive therapy regimes. A goal for future research would be including pretreatment PRWHE scores into a prospective study for patients with palmar midcarpal instability, and add a control group of patients not following the exercise program.

Conclusion

This is the first study evaluating the effectiveness of a wrist exercise program for patients with palmar midcarpal instability. We can conclude that the effectiveness of our wrist exercise program in patients with palmar midcarpal instability is promising for a wrist problem that is difficult to treat. Palmar midcarpal instability remains to be a chronic disease, reflected by the PRWHE score and the percentage of patients still having complaints after a median of 6 years. However, with the wrist exercise program, we can reduce pain, achieve acceptable long-term functional results, and a good quality of life.

Note

Ethical approval was obtained from the Institutional Review Board of our Hospital before start of this study, without the need for informed consent. This study was conducted at the Department of Plastic, Reconstructive, and Hand Surgery of the Academic Medical Center in Amsterdam, the Netherlands.

Conflict of Interest

None.

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Appendix Online survey

Personal details

1. What is your dominant hand?
□ Left
□ Right
□ Both

2. From which wrist, you have/used to have complaints? Please choose the wrist with the most complaints.
□ Left
□ Right
□ Both

Information regarding complaints of the wrist

3. Do you currently have complaints of the wrist indicated in the question above?
□ No (go to question 5)
□ Yes

4. What is your pain score at this moment? Zero indicates no pain at all, 10 indicates worse pain.
□ □ □ □ □ □ □ □ □ □ □
0 10

5. For how long did you already had complaints before your first visit to our hospital?
□ < 1 month
□ 1–3 months
□ 3–6 months
□ 6 months–1 year
□ > 1 year

6. What was your pain score at the first visit to our hospital? Zero indicates no pain at all, 10 indicates worse pain.
□ □ □ □ □ □ □ □ □ □ □
0 10

7. Did you follow a wrist exercise program, recommended by our hospital?
□ No (go to question 10)
□ Yes

8. In which practice did you receive treatment regarding the complaints of your wrist?
……
……..

9. For how long did you receive treatment in this practice?
□ < 1 month
□ 1–3 months
□ 3–6 months
□ 6 months–1 year
□ > 1 year

10. How many treatments of the wrist exercise program have you followed?
□ < 5 treatments
□ 5–10 treatments
□ 10–15 treatments
□ > 15 treatments

11. What kind of exercises have you followed during the wrist exercise program? (multiple answers allowed)
Exercises focused on:
□ A correct position of wrist and hand (e.g., "straight wrist" during lifting, supportive bandage, recommendations regarding position of the hand)
□ Improvement in strength (e.g., squeeze ball, exercise band)
□ Stabilization of the wrist (e.g., "powerball," movement with dumbbell with resistance, stabilization of a stock)
□ Coordination (e.g., rolling of marbles, catching balls)
□ Complex movements (e.g., rhythmic movement, drumming, balance exercises, "exercises with eyes closed")
□ Mobility and flexibility (e.g., exercise extreme positions, passive movement of wrist)
□ Pain control and perception (e.g., medication, TENS, injections, "dry needling")
□ Massage/manipulation (e.g., "straighten" of the wrist bones)
□ Infrared or ultrasound
□ Other, namely .....
.....

12. What was the effect of the exercise program you followed, immediately after the treatment was finished? Zero means no effect, 10 is the maximum effect.
□ □ □ □ □ □ □ □ □ □ □
0 10

13. Did you receive additional treatment for your wrist after the exercise program?
□ No (go to question 15)
□ Yes

14. I received additional treatment, namely
□ Operation
□ Other treatment by physical therapist
□ Other, namely .....
.....

15. Did you suffer from a new trauma of your wrist which increased the complaints of your wrist, after you finished the wrist exercise program?
□ No
□ Yes, namely .....
.....

16. What is your current occupation/job?
.....

17. Did you have to adjust your occupation/job due to the complaints of your wrist?
□ No
□ Yes, namely .....
.....

18. I am able to perform my occupation/job:
□ Fully
□ Adapted, due to the complaints of my wrist
□ I am not able to perform my occupation/job, due to the complaints of my wrist
□ Other, namely .....
.....

19. The wrist exercise program I followed:
□ Had no influence on my occupation/job
□ Due to the wrist exercise program, I could return to my old occupation/job
□ Due to the wrist exercise program, I needed less adaptions